DOCUMENT RESUME

ED 235 367 CE 037 284

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TITLE Pre-Alignment Checks. Automotive Mechanics. Steering & Suspension. Instructor's Guide [and] Student Guide.
INSTITUTION State Fair Community Coll., Sedalia, Mo.
REPORT NO AM-83-271
PUB DATE Feb 83
NOTE 15p.; For related documents, see CE 037 282-287. Audiocassette and 35mm slide presentation are not available with this document.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Auto Mechanics; Behavioral Objectives; Classroom Techniques; *Equipment Maintenance; Guidelines; Individualized Instruction; Instructional Materials; *Job Skills; Learning Modules; *Mechanical Skills; Postsecondary Education; Secondary Education; *Trade and Industrial Education
IDENTIFIERS Automobile Alignment; Automobiles; *Steering (Automotive); *Suspension (Automotive)

ABSTRACT

This instructional package, one in a series of individualized instructional units on automotive steering and suspension, consists of a student guide and an instructor guide dealing with prealignment checks. Covered in the module are the following steps in a prealignment check: checking the ride height of a vehicle, checking the ball joints and the suspension pivot point, checking the front wheel run-out, checking the steering linkage, checking the stabilizer and shock absorbers, and checking the rear-end mounting and pivot points. The student module contains an introduction, a list of procedures for completing the module, and an information sheet. Included in the instructor guide are an introduction, performance objectives, a list of references, suggested instructional methods, a suggested activity, a prealignment check worksheet, a student test, answers to the student test, and an instructional script. (MN)

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INSTRUCTOR'S GUIDE

PROGRAM: AUTOMOTIVE MECHANICS **UNIT TITLE:** STEERING & SUSPENSION

MODULE TITLE: PRE-ALIGNMENT CHECKS **MODULE NO.** AM-83-271

INTRODUCTION:

Perhaps more important than the front-end alignment itself, is the pre-alignment check. Any excessive wear or looseness in the steering or suspension system will make an accurate front-end alignment impossible.

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PERFORMANCE OBJECTIVES:

Upon completion of this module, the student should be able to:

1. Check the ride height of the vehicle.
2. Check the ball joints and the suspension pivot points.
3. Check the front wheel run-out.
4. Check the steering linkage.
5. Check the stabilizer and shock absorbers.
6. Check the rear-end mounting and pivot points.

Learning Groups Designed For:

- X **Adult**
- ____ **Special Needs**
- X **Secondary**
- X **Post Secondary**

Written By:

B. Spignesi 2-83

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TEACHING/LEARNING RESOURCES:

1 Student Packet	_____ Videocassette
1 Instructor's Guide, Key, and Script	_____ Film Loop
1 35mm Slide Presentation	1 Audiocassette
_____ Filmstrip	

Automotive Hoist or Jack & Safety Stands
Automotive Service Manuals
Ball Joint Gauge

REFERENCES:

1. Factory Service Manual for vehicle being checked.
2. Crouse, William H., Anglin, Donald L., Automotive Chassis and Body, McGraw-Hill Inc. 1976.
3. Abbott, Sheldon L., Hinerman, Ivan D., Suspension and Steering, Glencoe Publishing Co., Inc. 1982.

INSTRUCTIONAL METHODS SUGGESTED:

This module is designed to be used in individualized instructional programs where scheduling is open entry/open exit. However, they may be adapted for use in traditional instructional programs. Tests can be used for pre-testing for advanced placement of students who are already competent in this area. Demonstrations by the instructor are recommended to enhance student learning.

SUGGESTED ACTIVITY:

Perform a pre-alignment check and complete a report on the results of the check.

The instructor should provide the student with a copy of the pre-alignment check worksheet provided in the instructor and student guide.

PRE-ALIGNMENT CHECK WORKSHEET

Indicate with a check mark any item that does not meet acceptable wear limits.

	ACCEPTABLE	NOT ACCEPTABLE
1. Vehicle Ride Height		
2. Ball Joint Play (Upper)		
A. Horizontal		
B. Vertical		
3. Ball Joint Play (Lower)		
A. Horizontal		
B. Vertical		
4. Control Arm Bushings		
A. Upper Right		
B. Lower Right		
C. Upper Left		
D. Lower Left		
5. Front Wheel Runout		
6. Steering Linkage		
A. Right Outer Tie Rod End		
B. Right Inner Tie Rod End		
C. Left Outer Tie Rod End		
D. Left Inner Tie Rod End		
E. Idler Arm		
F. Center Link		
7. Stabilizer Mounts		
8. Shock Absorbers		
9. Rear Suspension		
A. Control Arms		
B. Spring Mounts (Right)		
C. Spring Mounts (Left)		

KEY

STUDENT EVALUATION

PRE-ALIGNMENT CHECK

NOTE: Before taking this test you must have:

A. Read and studied the supportive material in this module.
B. Watched the slide/tape presentation "Pre-Alignment Check."
C. Completed the activity worksheet in this module.

1. When the lower ball joint on a control arm suspension system is the load carrying joint, the stands must be placed under the LOWER CONTROL ARM to unload the joint for checking.
2. On a McPherson strut front end, the stands must be placed under the FRAME to unload the ball joint.
3. On a control arm suspension where the upper ball joint is the load carrying joint, place the stands under the FRAME to unload the ball joints for checking.
4. The three types of springs used in the automotive suspension systems are LEAF, COIL, and TORSION BAR.
5. The devices used on rear suspension with coil springs that connect the axle housing to the frame and prevent twisting and back and forth movement are called CONTROL ARMS.
6. On most TORSION BAR type front suspension systems, the vehicle ride height is adjustable by turning a bolt.
7. Vehicle ride height specifications can be found in the SERVICE MANUAL for the vehicle you are working on.
8. The idler arm is connected to the PITTMAN ARM through the center link.
9. List two problems caused by excessive looseness in the steering linkage.
   a. TIRE WEAR
   b. WANDER
10. Wheels that wobble from side to side when rotated are said to have RUN OUT.

AM-83-271 STEERING AND SUSPENSION PRE-ALIGNMENT CHECKS FOR PASSENGER CARS - SCRIPT

1. A presentation of The Media Center, State Fair Community College, Sedalia, Missouri.

2. AM-83-271 STEERING AND SUSPENSION PRE-ALIGNMENT CHECKS FOR PASSENGER CARS

3. Perhaps more important than the front-end alignment itself is the pre-alignment check.

4. Unusual tire wear can be a signal of a serious condition that may not be detected during or cured by an alignment.

5. Weak, sagging springs can not only affect the ride and handling of the car but can make correct alignment impossible.

6. There are many pivot points in the steering and suspension system. Any looseness here is a safety hazard and will also cause the alignment to change during driving.

7. The rear end should not be neglected as its alignment directly affects the front-end alignment.

8. After completing this lesson you should be able to: (1) Check the ride height of the vehicle.

9. (2) Check the ball joints and the suspension pivot points.

10. (3) Check the front wheel run-out.

11. (4) Check the steering linkage.

12. (5) Check the stabilizer and the shock absorbers.

13. (6) Check the rear-end mounting points and pivot points.

14. The pre-alignment check begins with vehicle height measurement. Even a small amount of sag can force steering and suspension parts out of their normal operating positions, making alignment angle incorrect.

15. The only way to detect this sag is to make precise measurements following the manufacturer's specifications, as shown in this example.

16. Start by positioning the car on a flat, level floor.

17. Check and adjust the tire pressure to the manufacturer's recommendations. Non-standard tires or excessive wear will affect ride height so check with your instructor if this is the case.

18. Check the trunk. It should contain only the spare tire and the jack.

19. The fuel tank should be full. If not, consult your instructor regarding the allowances to be made.

20. The car must be empty of all passengers and any items which are not part of the car itself. The front seat should be adjusted to its most rearward position.

21. As the ride height and measuring points differ with each vehicle, consult the service manual for the specifications on the vehicle you are checking.

22. On this car, the measurement is taken from the floor to the rocker panel at specified points, front and rear.

23. If the vehicle height is not within the manufacturer's recommendations, the cause must be corrected before alignment angles can be set.

24. On cars using torsion bars instead of coil springs, the front-end height can be adjusted by turning an adjustment bolt.

25. The next step of the check requires raising the front-end of the car and supporting it in a manner that will unload the ball joints.

26. If the lower ball joint is the load carrying joint, place the safety stands under the lower control arms as close to the wheel as possible and remove the jack.

27. If the upper ball joint is the load carrying joint, place the safety stands under the frame of the car.

28. On McPherson Strut-type front-ends, also support the car by placing the stands under the frame.

29. With the ball joints now unloaded, grasp the top and bottom of the tire and attempt to move it back and forth.

30. At the same time, watch for any movement in the suspension system pivot points which would indicate worn parts needing replacement.

31. Also, any movement in the front-wheel bearings would indicate the need for adjustment or replacement.

32. Next, position the ball joint gauge to detect vertical movement and gently pry up and down. The reading on the gauge should be compared with the manufacturer's ball joint wear limit specifications.

33. Run-out, or wobble of the front wheels, is the next thing to check. This condition can occur from a defective tire or wheel that is bent, excessive run-out will cause tire wear and shimmy and make accurate alignment impossible.

34. With the gauge positioned as shown, rotate the wheel. The amount of run-out detected should be compared with the specifications for maximum allowable run-out.

35. The condition of the steering linkage is particularly important to front-end alignment. Any play or looseness in these components will cause steering wander and tire wear.

36. A loose tie rod end can be detected by grasping the tie rod and moving it firmly up and down. If any play is detected, the tie rod end should be replaced.

37. The idler arm,

38. which is a partner of the pittman arm,

39. holds the center link in position.

40. Check the idler arm by attempting to move it up and down. If any movement is detected, check with your instructor as the idler arm may need to be replaced.

41. The rubber boots on the steering linkage should be checked for excessive cracking or holes which could cause the loss of lubricant and allows dirt and water to enter the joint and can cause premature wear.

42. The rubber bushings on the suspension parts should be checked for cracking and wear.

43. Inspect the stabilizer mounts and the bushings where they attach to the frame

44. and the links and bushings where the stabilizer mounts to each lower control arm. Looseness at any of these points will minimize the stabilizing effect upon the car.

45. Inspect the shock absorbers for secure mounting, damage, and signs that fluid they contain is leaking.

46. Look for missing or loose fasteners on all undercarriage components. In this case, a cotter pin missing would allow the nut to work loose and let the tie rod end drop out of the eye of the center link during driving. The result would be the loss of steering control.

47. The condition of the rear suspension is often overlooked, but it plays an important part in the vehicle's total alignment and can become out of alignment itself.

48. Inspect for signs of uneven, unusual wear on the tires which could indicate a problem with suspension alignment or tire balance.

49. On leaf-spring type rear suspension, inspect for worn or missing shackle bushings,

50. signs of movement where the axle housing attaches to the springs,

51. and cracked or broken spring leaves.

52. With coil spring rear suspension, the control arms are a critical point as they hold the rear axle in its correct position.

53. Inspect the control arm pivot points for worn or missing bushings.

54. On cars with a rear stabilizer, check the control arm mounting points just as you did at the front.

55. It is a good idea, before completing the pre-alignment check to visually inspect the body and frame of the car for signs of accident damage which can upset the vehicle alignment. Check with your instructor if you find bent or damaged parts.

56. The pre-alignment check is now complete. It should be noted that this check is a perfect opportunity to make a note of any safety related problems that may be detected, such as this rusted-out muffler.

57. Let us summarize the material covered in this lesson.

58. To check the ride height correctly position the car on a level floor, check tire pressures, remove all extra items from car, establish fuel level allowance, adjust front seat rearward, and refer to manufacturer's specifications.

59. To check ball joints and suspension pivot points, place safety stands correctly, unload ball joints, attempt to move tire from side to side and watch for movement in pivot points and wheel bearings, and use a ball joint gauge to detect vertical movement.

60. Use a ball joint gauge to check the front wheel run-out, and compare the reading to the manufacturer's tolerance.

61. Check the steering linkage--the tie rods, idler arm, pittman arm and center link--for vertical looseness.

62. Inspect the stabilizer mountings--to the frame and control arms--at the front and on some cars, at the rear, too. Check the shock absorbers for secure mounting and signs of leakage.

63. Determine the condition of the rear-end suspension by checking for unusual tire wear, movement of the exle on leaf springs, defective springs, control arm mounting, and pivot points.

64. Throughout the pre-alignment check be alert for two things: deteriorated or missing rubber boots and bushings, which could allow dirt and water to enter a moving part or cause looseness at a pivot point; and loose or missing fasteners, which might allow a vital part to work loose and cause an accident.

65. (CREDITS)

66. (DISCLAIMER)

67. (REWIND)

STUDENT EVALUATION

PRE-ALIGNMENT CHECK

NOTE: Before taking this test you must have:

A. Read and studied the supportive material in this module.
B. Watched the slide/tape presentation "Pre-Alignment Check."
C. Completed the activity worksheet in this module.

1. When the lower ball joint on a control arm suspension system is the load carrying joint, the stands must be placed under the _____ _____ to unload the joint for checking.
2. On a McPherson strut front end, the stands must be placed under the _____ to unload the ball joint.
3. On a control arm suspension where the upper ball joint is the load carrying joint, place the stands under the _____ to unload the ball joints for checking.
4. The three types of springs used in the automotive suspension systems are _____, _____, and _____.
5. The devices used on rear suspension with coil springs that connect the axle housing to the frame and prevent twisting and back and forth movement are called _____.
6. On most _____ type front suspension systems, the vehicle ride height is adjustable by turning a bolt.
7. Vehicle ride height specifications can be found in the _____ _____ for the vehicle you are working on.
8. The idler arm is connected to the _____ through the center link.
9. List two problems caused by excessive looseness in the steering linkage.
   a. _____
   b. _____
10. Wheels that wobble from side to side when rotated are said to have _____ _____.

STUDENT GUIDE

PROGRAM: Auto Mechanics **UNIT TITLE:** Steering & Suspension

MODULE TITLE: Pre-Alignment Checks **MODULE NO.** AM -83-271

PERFORMANCE OBJECTIVES:

After completing this module you should be able to:

1. Check the ride height of the vehicle.
2. Check the ball joints and the suspension pivot points.
3. Check the front wheel run-out.
4. Check the steering linkage.
5. Check the stabilizer and shock absorbers.
6. Check the rear-end mounting and pivot points.

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INTRODUCTION

Perhaps more important than the front-end alignment itself, is the pre-alignment check. Any excessive wear or looseness in the steering or suspension system will make an accurate front end alignment impossible.

PROCEDURES

1. Read the objectives and introduction to this module.
2. If you feel you can pass a test over the objectives with 90 percent accuracy, ask your instructor for the pretest.
3. If you do not take the pretest or do not meet the minimum requirements on the pretest, continue with the next procedure.
4. Study the information sheets which are part of this learning packet.
5. Observe and listen to slide/tape presentation AM-83-271, "Pre-Alignment Checks."
6. For additional information refer to the following resources:
   a. Factory Service Manual for vehicle being checked
   b. Crouse, William H., Anglin, Donald L., Automotive Chassis and Body, McGraw-Hill Inc., 1976,
   c. Abbott, Sheldon L., Hinerman, Ivan D., Suspension and Steering, Glencoe Publishing Co., Inc., 1982.
7. Complete the activity sheet which is part of this learning packet.
8. Review the objectives to be certain you understand what you are expected to have learned. Performance of these objectives will be evaluated on the posttest.
9. Ask your instructor for a test over this module. You are required to achieve at least 90 percent accuracy on this module before proceeding to the next module.
10. When you pass the test with 90 percent or better accuracy, proceed to the next module.

PRE-ALIGNMENT CHECK WORKSHEET

Indicate with a check mark any item that does not meet acceptable wear limits.

	ACCEPTABLE	NOT ACCEPTABLE
1. Vehicle Ride Height		
2. Ball Joint Play (Upper)		
A. Horizontal		
B. Vertical		
3. Ball Joint Play (Lower)		
A. Horizontal		
B. Vertical		
4. Control Arm Bushings		
A. Upper Right		
B. Lower Right		
C. Upper Left		
D. Lower Left		
5. Front Wheel Runout		
6. Steering Linkage		
A. Right Outer Tie Rod End		
B. Right Inner Tie Rod End		
C. Left Outer Tie Rod End		
D. Left Inner Tie Rod End		
E. Idler Arm		
F. Center Link		
7. Stabilizer Mounts		
8. Shock Absorbers		
9. Rear Suspension		
A. Control Arms		
B. Spring Mounts (Right)		
C. Spring Mounts (Left)		

INFORMATION SHEET

Total vehicle adjustment allows the wheels to roll straight and true with a minimum of side slip. When aligned correctly, the vehicle will handle well and the tire wear will be within acceptable limits. In order to achieve this total vehicle alignment it is necessary that all of the components of the vehicle that affect the alignment be within tolerance. This means there must not be any excessively worn, damaged, or bent parts or any parts that are not securely mounted which could cause them to shift from their original position.

The pre-alignment check is necessary to ensure that the vehicle is alignable.

The modern vehicle has many pivot points in the front end of the ball and socket type; similar in design to the ball and socket of your ball point pen. The ball joints, either two or four per vehicle, are the connecting and pivot point of the front wheels.

The ball and socket type joint makes it not only possible for the wheels to turn, but also allows the suspension to flex up and down at the same time. It is obvious any wear in these joints will cause unwanted side to side or up and down movement making alignment settings change along with it.

This module will cover the correct procedure for checking ball joints for excessive wear.

The steering linkage also has ball and socket joints on the tie rod ends and center link. Wear in these will cause unwanted side to side movement, especially bad if you are wanting to go straight.

Most other pivot points on the suspension systems are mounted on rubber bushings. These bushings are flexable enough to allow for normal movement but must be tight enough to prevent any unwanted movement.

The rear suspension must also allow for up and down movement but also must not allow any side to side, back and forth or twist of the rear axle assembly. All of the rear suspension points that must pivot for the normal up and down movement are mounted with rubber bushings. The pre-alignment check must include an inspection of these points and any worn parts replaced before the alignment is done.

INFORMATION SHEET

Probably the most frequent result of worn, damaged, misalignment parts are excessively or unevenly worn tires. A check of the tire tread should be made as this could be a clue to a worn or damaged part affecting the alignment of that wheel.

In summary: Most frequently misalignment is caused by worn or damaged steering and suspension parts. So perform your pre-alignment check carefully. The quality of the alignment job that follows will depend on it.